

The Exploration of Mars by Humans: Why Mars? Why Humans?

Dr. Joel S. Levine
Science Directorate
NASA Langley Research Center
Hampton, VA 23681-2199
Joel.s.levine@nasa.gov

As we commemorate the 50th anniversary of Yuri Gagarin's historic flight in 1961, the first flight of a human in space, plans are underway for another historic human mission. Plans are being developed for a human mission to Mars. Once we reach Mars, the human species will become the first two-planet species. Both the Bush Administration (in 2004) and the Obama Administration (in 2010) proposed a human mission to Mars as a national goal of the United States.

The reasons for a human mission to Mars are several and include (1) The human urge to explore new and distant frontiers, (2) Inspiring the American public and the next generation of scientists and engineers (following the launch of Sputnik I by the USSR on October 4, 1957, the U. S. and the rest of the world witnessed a significant increase in the number of students going into science and engineering), (3) Enhanced national prestige, (4) Technological leadership, (5) Enhanced national security, (6) The development of new technologies for potential non-space spin-off applications, (7) Enhanced economic vitality, and (8) Scientific discovery not obtainable from robotic missions to Mars (how did Mars evolve from an early Earth-like, hospitable planet to its present inhospitable state? Is there life on Mars?). Some have suggested other reasons for colonizing the Red Planet are more catastrophic in nature, including Mars as a safe haven for the survival of the human species in the event of an impact with a large asteroid or comet (remember the demise of the dinosaurs 65-million years as a result of an asteroid or comet impact!). Some have even suggested that the colonization of Mars may be a solution to the global exponential population explosion on our planet!

Why Mars? One of the major questions in all of science is whether there is life outside of the Earth. After Earth, Mars is probably the most likely planet in the Solar System to have life. Is there life on Mars today? If so, what is the structure and chemical composition of this life? Is it similar to life on our planet?

It is generally believed that Mars has experienced catastrophic climate change over its history. Scientists think that early Mars was more hospitable and more Earth-like than present-day Mars. Present-day Mars has a very thin atmosphere with a surface pressure of only about 6 millibars, comparable to the pressure of the Earth's atmosphere at an altitude of about 100,000 feet (For comparison, the surface pressure of the Earth's atmosphere is 1013 millibars). The surface of present-day Mars is devoid of liquid water. Early Mars most probably possessed an atmosphere considerably denser than the present-day atmosphere. Photographs of Mars from orbit and from the surface suggest that early

in its history Mars possessed abundant liquid water in the form of lakes, rivers and even planetary-scale oceans. What processes or mechanisms caused Mars to experience catastrophic climate change? What happened to the bulk of the atmosphere of Mars? What happened to the liquid water on the surface of early Mars? Does the climate change on Mars portend similar changes on our planet?

Why humans? Humans are unique scientific explorers and observers. Humans have unique capabilities for performing scientific measurements, observations and sample collecting. Human attributes needed for exploration and scientific discovery include: intelligence, adaptability, agility, dexterity, cognition, patience, problem solving in real-time, in situ analyses - more science in less time! Humans can obtain previously unobtainable scientific measurements on the surface of Mars. Humans possess the abilities to adapt to new and unexpected situations in new and strange environments, they can make real-time decisions, have strong recognition abilities and are intelligent. Humans can perform detailed and precise measurements of the surface, subsurface and atmosphere while on the surface of Mars with state-of-the-art scientific equipment and instrumentation brought from Earth. The increased laboratory ability on Mars that humans offer, would allow for dramatically more scientific return within the established sample return limits. The scientific exploration of Mars by humans would be performed as a synergistic partnership between humans and robotic probes, controlled by the human explorers on the surface of Mars. Robotic probes could explore terrains and features not suitable or too risky for human exploration. Under human control, robotic probes could traverse great distances from the human habitat covering distances/terrain too risky for human exploration and return rock and dust samples for analysis and interpretation to the habitat from great distances.

The unambiguous detection of life on Mars and the mechanisms/processes of climate change are not easy to determine using robotic techniques. The human explorer/scientist can adapt to new and unexpected situations that Mars may provide.

Editor's Note: Levine and Rudy E. Schild (Harvard-Smithsonian Center for Astrophysics, Cambridge, MA) edited the 974-page volume, *The Human Mission to Mars: Colonizing the Red Planet*," a collection of 55 papers covering all aspects of a human mission to Mars published by the Cosmology Science Publishers, Cambridge, MA in December 2010. A lecture by Levine, "Why We Need to Go Back to Mars," may be viewed at: http://www.ted.com/talks/joel_levine.html